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POLYVINYL ACETATE ADHESIVE MIXTURE

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This invention relates to the production of improved adhesive compositions based on polyvinyl acetate; more particularly, it relates to aqueous emulsions of polyvinyl acetate compounded with complex mixtures of other ingredients which impart to these emulsions properties heretofore considered antithetical.

To use polyvinyl acetate in emulsion form is of course well known in the adhesive art. Yet, on applying these emulsions to substrates at low temperatures, say at 45° F., there is left on the substrates, upon drying, a chalky, discontinuous film. This defect in filming property has been remedied to some extent by the addition of coalescing agents to the emulsions. These agents are volatile organic solvents; they increase the cold flow of the drying polymer and then they evaporate along with the water forming the emulsion. To improve the filming property of polyvinyl acetate in this manner however, is done at the expense of the redispersibility of the dry polymer film, a property that is rather important for certain applications.

Polyvinyl acetate in film form its not, in the first place, remarkably redispersible in itself. Increased redispersibility is usually achieved by incorporating in the emulsion a hydrophilic, protective colloid which may be either natural or synthetic. Starch and certain types of polyvinyl alcohol illustrate the class of materials suitable for this function.

In spite of these developments, however, there remains a need for aqueous polyvinyl acetate emulsions which can deposit completely water redispersible films and yet form such films at low temperatures.

It is therefore an object of this invention to provide aqueous polyvinyl acetate emulsions which combine the mutually adverse properties of low filming temperature and redispersibility of film. It is also intended that these adhesive emulsions shall have high cohesive strength when wet, i.e., they shall have excellent "wet tack." Further, the emulsions shall be stable to consecutive freezing and thawing, shall suffer little change in viscosity upon dilution and shall tolerate such liquids as carbon tetrachloride and the lower alkyl ethers of ethylene glycol.

These and other objects have been accomplished by mixing an emulsion of polyvinyl acetate with an aqueous solution of certain types of polyvinyl alcohol and another solution containing thiourea or a thiocyanate as well as other ingredients such as starch or animal glue, boric acid and so on.

The following examples will illustrate typical embodiments of the mixtures. They are not intended to limit the invention in any manner. The compositions and their significant properties are summarized in tabular form.

The compositions below, as shown by the emulsion and film properties measured, all meet the requirements set for the adhesive compositions of the invention.

Good wet tack is that property of an adhesive which is evidenced by the formation of stringy legs when two surfaces coated with a thin wet film of the adhesive are slowly separated.

Filming ability at 45° F. is scored excellent when the compounded adhesive emulsion, after application to a substrate and upon drying in air, leaves a uniform, nonchalky and continuous film. A few isolated areas of whiteness on a continuous film still earns a rating of good

low temperature filming ability for the emulsion producing that film.

Example	I	II	III	IV	V
	Parts by weight				
Composition:					
Polyvinyl acetate emulsion—					
Gelva S–51	53.04	49.1	54.0		
Gelva S–55H				34.3	55.0
Thiourea	1.92	1.72	3.7		1.92
NH_4CNS				1.8	
Animal glue	0.33	0.37	0.41		0.33
Starch				10.0	
Boric acid	0.69	0.49	0.55	1.20	0.69
Acetic acid, glacial	0.008	0.003	0.003		
Phosphoric acid (85%)				0.1	
Water	14.82			23.1	
Gelvatol 70/10	0.05			0.04	
Gelvatol 20/30	1.64	1.41	1.09	7.4	1.09
Gelvatol 20/60	2.43	3.18	2.45		2.45
Gelvatol 20/90	0.82	1.76	1.36		1.36
Water	23.22	42.2	36.7	14.4	37.2
Tamol 731 (25%)	0.022				
Clay	1.00			7.2	
Dye, Fungicide				0.5	
Emulsion Properties:					
Total solids (percent weight)	37.9	35.9	39.0	47.1	38.8
Viscosity, c.p.s	3,810	4,820	3,556	4,100	3,200
Tack (wet)	excellent	excellent	v. good	v. good	v. good
Film Properties:					
45° F. filming	excellent	good	v. good	good	good
Redispersibility	excellent	v. good	v. good	v. good	good
Wood bonding—					
Average strength (p.s.i.)	3,207	3,700	3,333	3,288	3,700
Wood failure (ave. percent)	58	78	44	50	61

Excellence in redispersibility is that degree of redispersibility which causes a dry film of the present compositions to redisperse much like a wet film of ordinary emulsions would, except that it occurs more slowly. Redispersibility is complete, although usually accompanied by very slight to slight evidence of shredding of the film.

The wood bond strength is the average shearing force, in pounds per square inch, necessary to break maple blocks bonded by the compositions. The differences in average strengths given for the above examples is not too significant because of the various factors influencing these values, which factors cannot be controlled practically with as much precision as would be desired, e.g., wood grain structure, internal defects of blocks, rate of shear and so on. Nevertheless, wood bonding characteristics are considered acceptable when strength exceeds 3000 p.s.i., and when more than 40% of the test specimens break because of wood failure rather than because of adhesive bond failure. Each composition is tested on 10 specimens by means of a hydraulic press.

Emulsion viscosities are measured at room temperature on a Brookfield LV viscosimeter, employing a No. 3 spindle at 12 r.p.m.

"Gelva S–51" polyvinyl acetate emulsion is a commercially available product. The particular batch used here had a minimum solids content of 55% by weight, a room temperature viscosity of 4000 centipoises and a pH of 4.5. The number average molecular weight of the polymer was approximately 600,000 and the particle size ranged between 1 and 2 microns in diameter. Similarly, "Gelva S–55H" was a commercially available aqueous emulsion of polyvinyl acetate of the following characteristics: minimum total solids, 55% by weight; room temperature viscosity, 1650 centipoises; pH, 4.5; number average molecular weight, approximately 50,000; and particle size range, from 0.1 to 5.0 microns in diameter. Both emulsions contained polyvinyl alcohol as stabilizer.